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Total Wrist Arthrodesis: A Preoperative Test to Predict Functional Outcomes

Artrodese total do punho: Um teste pré-operatório para prever resultados funcionais

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Abstract

Objective The study aims to demonstrate an evaluation method to predict the functional success of total wrist arthrodesis (TWA) and assist its indication.

Methods A prospective study including ten patients submitted to (TWA) posttraumatic arthritis. Exclusion criteria were patients who lost postoperative follow-up or incomplete information in the medical record. The objective functional assessment (handgrip strength, three-point pinch, lateral pinch and pulp-pulp pinch) and the subjective functional assessment (DASH, PRWE, EVA) were evaluated in 3 different periods: (1) Before surgery without articular anesthesia, (2) Before surgery under articular anesthesia and (3) 12 weeks after the surgical procedure.

Results There was an increase in handgrip strength in all three pinches measurements after pain relief, both after joint anesthesia and after the consolidation of the arthrodesis ($p < 0.05$). In the comparisons between the subjective evaluations (DASH, PRWE and VAS), the patients had better scores in the postoperative evaluation after 12 weeks ($p < 0.05$). There was no statistical difference when comparing the mean strength values found after anesthesia and after 12 weeks of TWA.

Conclusion the outcomes could propose an assessment protocol for patients with indication for TWA, in which patients with good response to intra-articular anesthetic infiltration would benefit from the effects of the surgical procedure.

Keywords
- arthrodesis
- wrist joint
- wrist

Resumo

Objetivo O estudo tem como objetivo demonstrar um método de avaliação para predizer o sucesso funcional da artrodese total do punho (ATP) e auxiliar na sua indicação.

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Métodos Um estudo prospectivo incluindo dez pacientes submetidos a ATP por artrite pós-traumática. Os critérios de exclusão foram pacientes que perderam o acompanhamento pós-operatório ou informações incompletas no prontuário. A avaliação funcional objetiva (força de preensão manual, pinça de três pontos, pinça lateral e pinça polpa-a-polpa) e a avaliação funcional subjetiva (DASH, PRWE, EVA) foram avaliadas em 3 momentos diferentes: (1) Antes da cirurgia sem anestesia articular, (2) Antes da cirurgia sob anestesia articular e (3) 12 semanas após o procedimento cirúrgico.

Resultados Houve aumento da força de preensão palmar nas três medidas de pinça após o alívio da dor, tanto após a anestesia articular quanto após a consolidação da artrodese ($p<0,05$). Nas comparações entre as avaliações subjetivas (DASH, PRWE e VAS), os pacientes tiveram melhores escores na avaliação pós-operatória após 12 semanas ($p<0,05$). Não houve diferença estatística ao comparar os valores médios de força encontrados após a anestesia e após 12 semanas de ATP.

Palavras-chave
- articulação do punho
- artrodese
- punho

Introduction

Whether for strength or precision activities, functional use of the hand depends on a stable and painless wrist. Instability and pain imply impairment of function and require treatment.[1] Total wrist arthrodesis (TWA) is a well-established procedure that results in predictable pain relief and satisfactory function in patients with inflammatory, degenerative, and post-traumatic pathologies.[2]

The main indication for TWA is an active individual who suffers from radiocarpal and midcarpal arthritis, remaining symptomatic after conservative treatment and has no indication for procedures that preserve wrist mobility.

Patients undergoing TWA show decreased pain and improved grip strength and quality of life. It is reasonable to think that pain is one of the causes of the reduced grip strength of the affected limb and, consequently, it increases the risk of the patient presenting dysfunction in routine tasks.

The study aims to demonstrate a new evaluation method, which consists of an objective analysis of handgrip and pinches strength after intra-articular block with anesthetic, to predict the functional success of TWA and assist its indication. It also can give the patient a prediction of the outcome of the surgery.

Methods

This study was approved by our institutional review board (CAAE 34609220.6.0000.5440). The patient and his family were informed that data from the case would be submitted for publication and gave their consent.

Twenty patients with an indication of total wrist arthrodesis were prospectively evaluated. Inclusion criteria were patients with posttraumatic wrist arthritis. Exclusion criteria were patients who lost postoperative follow-up or incomplete information in the medical record. Thus, only ten patients were eligible for this study. The statistical power was analyzed and adequated to the sample size, being necessary for ten patients for a confidence interval of 95% (McNemar's Z-test, 1-Sided).

Functional assessment of the wrist was performed in three moments: (1) before surgery without joint anesthesia; (2) before surgery under joint anesthesia; (3) and after at least 12 weeks after the surgical procedure.

Clinical Evaluation

The functional assessment consisted of applying the Visual Analogue Scale (VAE), the Patient Rated Wrist Evaluation (PRWE) 37, and the Disabilities of the Arm, Shoulder, and Hand (DASH) 38 (Appendix I and II). The handgrip strength test and three digital pinches (pulp-pulp, lateral, and tripod) were performed with a pinch meter (►**Fig. 1**).

Radiocarpal Joint Anesthesia

After identifying the Lister's tubercle on the dorsal surface of the radius and, between the third and fourth extensor compartment, approximately 1cm distal to the tubercle, a soft spot corresponds to where the needle was inserted into the joint. Then, 5 mL of 1% lidocaine without vasoconstrictor in the radiocarpal joint of the affected wrist.

Operative Technique

The surgeries were all performed by the same surgeon (second author). The surgical technique was no different from the one commonly used in the service and widely described in the literature.[2–4]

Under anesthesia (regional brachial plexus, general inhalation or combined), the affected wrist was approached through a dorsal longitudinal incision—the extensor retinaculum, between the 3rd and 4th compartments, was opened. The joint capsule was incised longitudinally, and Lister's tubercle was resected to be used as a bone graft. The articular surfaces between the radius, scaphoid, lunate and capitate are carefully removed, avoiding excessive resection of the cancellous subchondral bone. The low-contact titanium wrist arthrodesis plate (TechImport®, Rio Claro, São Paulo, Brazil) was placed and fixed according to the dynamic compression technique.

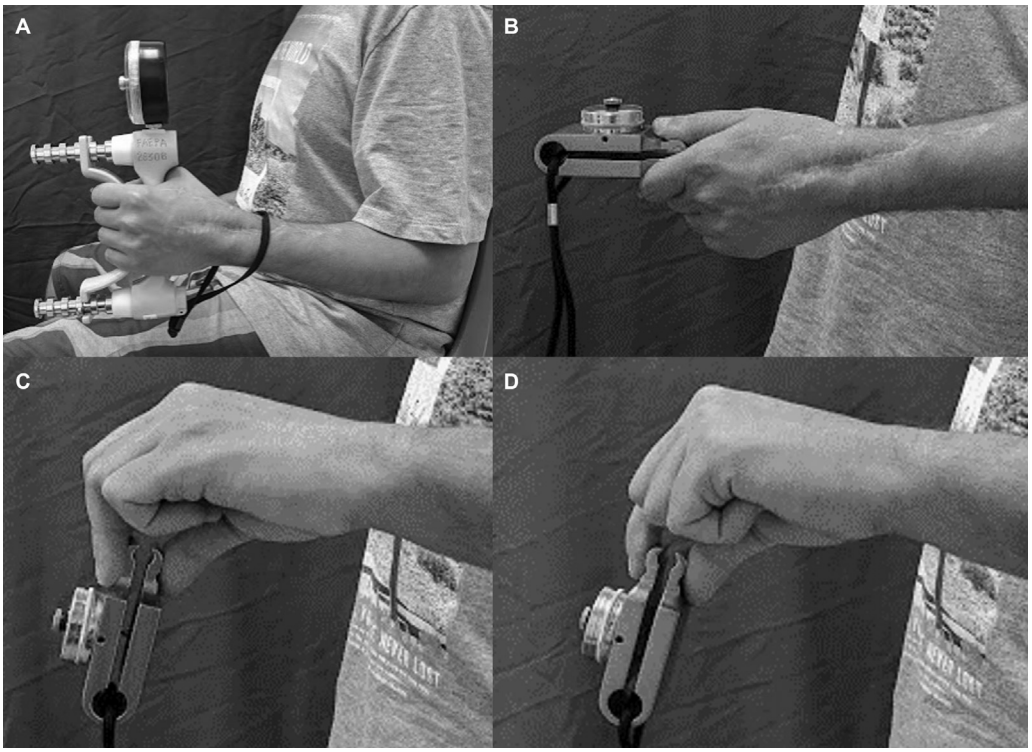

Fig. 1 Preoperative assessment. A. Handgrip dynamometer. B. Lateral pinch. C. Tripod pinch. D. Pulp-pulp pinch.

Postoperative

A volar plaster immobilization was placed after the surgery. The stitches were removed at 10-14 days; the immobilization was then changed for a wrist orthosis for ten weeks. During this time, the patient was allowed passive and active finger flexion and extension and wrist pronation and supination of the forearm. We evaluated the radiographic images every two weeks, and strength exercises were introduced only after radiographic confirmation of the arthrodesis consolidation.

A two-tailed p-value of less than 0.05 was considered statistically significant. All analyses were performed using SPSS for Os X, version 22.0.0 (SPSS, IBM Corp., NY).

Results

Twelve patients who underwent total wrist arthrodesis were included (►**Fig. 2**). We excluded two of them due to loss of follow-up. The data were obtained through evaluations of the ten patients. ►**Table 1** includes all the mean strength (in Kgf) measured and consists of an assessment of the unaffected limb, which presents, on average, more than twice the strength of the diseased wrist before surgery in the handgrip.

The handgrip and pinch strength increased after pain relief. In all parameters evaluated, the most expressive increase in strength occurred under the effect of the anesthetic, showing a statistical difference when compared to the state before the blockade for handgrip (Student T-test: $p = 0.022$), tripod pinch (Student T-test: $p = 0.007$), lateral pinch (Student T-test: $p = 0.007$) and pulp-pulp pinch (Student T-test: $p = 0.006$).

When comparing preoperative evaluations without anesthesia with the results acquired 12 weeks after the surgical procedure, patients showed substantial improvement in subjective assessment (DASH, PRWE and VAS) with statistical significance (Student T-test: $p < 0.05$). It was also possible to confirm the increased handgrip strength and tripod pinch after surgery concerning preoperative measurements (Student T-test: $p < 0.05$). Even with an improvement trend, there was no statistical significance for pulp-pulp pinch (Student T-test: $p = 0.087$) and lateral pinch ($p = 0.374$). These data are available in ►**Table 2**.

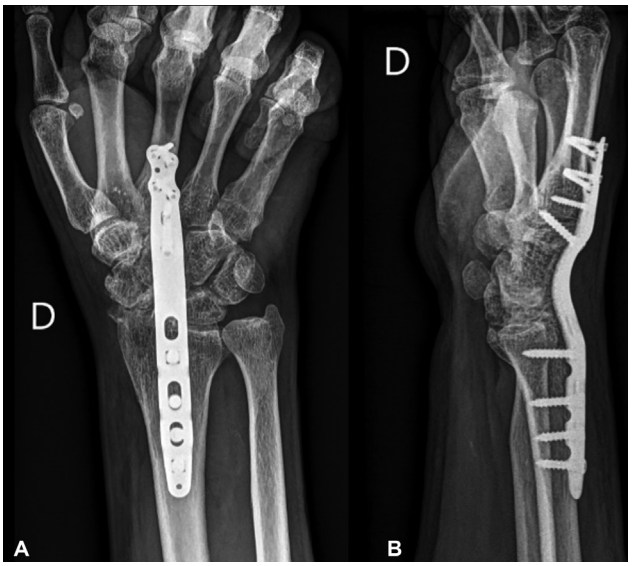

Fig. 2 Total Wrist Arthrodesis. A. Anteroposterior view. B. Lateral view.

Table 1 Strength averages (Kgf) measured according to the period of assessment

	Handgrip Strenght	Tripod Pinch	Lateral Pinch	Pulp-pulp Pinch
Before Anesthesy	15,57	4,33	5,67	3,63
After Anesthesy	21,00	6,27	7,87	5,33
Post Operative (12 Months)	18,83	5,57	6,47	4,97
Contralateral (unnafected side)	39,17	7,87	9,87	6,47
p-value (Student T-test)	0.002	0.007	0.007	0.006

*Student-T test.

Table 2 Subjective evaluations of patients before and after the surgical procedure

Case	Pain VAS Preoperative	Pain VAS Postoperative	DASH Preoperative	DASH Postoperative	PRWE Preoperative	PRWE Postoperative
1	7	0	45	27,5	48	38,5
2	2	0	53,3	30	74,5	61,5
3	8	1	96,7	57,5	94	63
4	6	0	40,8	35,8	63	48
5	5	3	61,7	21,7	83,5	43,5
6	6	0	68,3	33,3	82	65,5
7	8	0	73,3	40,8	80	42
8	7	0	70,8	39,2	82,5	55
9	7	0	66,7	22,5	70,5	35
10	3	0	68,3	27,5	63	38.5
p Value*	0.0002		0.0003		0.0008	

*Student T-test.

When comparing the mean strength values found after anesthesia and 12 weeks after performing total wrist arthrodesis, there was no statistical difference for any of the items evaluated.

There were no complications reported, and all the TWA presented bone fusion. None of the patients had suture dehiscence, tendon rupture, nerve damage, superficial or deep infection or union failure.

Discussion

There were improvements in function and quality of life comparing the preoperative and postoperative scores (DASH, PRWE and EVA) and correlating handgrip and pinch strength. Several other studies prove the analgesic effect of this procedure. Other studies reported a complete decrease in pain after total wrist arthrodesis in 76 to 100% of cases.[5–12]

Other authors demonstrate the relationship between the decrease in muscle strength, measured by handgrip strength, with a greater chance of developing incapacity to perform daily activities, which clarifies the significant functional impact.[13–30] Sauerbier et al.[15] measured the grip strength of patients with indication for total wrist arthrodesis due to post-traumatic arthrosis or Kienbock's disease, showing a 50% reduction concerning the healthy side. These data are similar to those found in our study, which demonstrated a mean decrease in grip strength of more than 100% compared to the unaffected side (►**Table 1**).

The study aimed to establish a predictability factor for functional outcomes based on the response to the preoperative anesthetic block. The use of anesthetics as a preoperative evaluation for arthrodesis remains unclear in the literature. Stegeman et al.[4] correlated the joint function after preoperative anesthesia with the functional outcomes after ankle arthrodesis. They concluded that the anesthetic block was not valuable as a diagnostic tool since patients that underwent surgery had good functional results regardless of the result of the anesthetic block.

The main question about total wrist arthrodesis is, "Why is a preoperative test to evaluate pain relief necessary if that's the goal of the procedure?". The answer is that some patients still complain about wrist pain or other symptoms after the total wrist fusion. There are pain symptoms in the DRUJ (Distal RadioUlnar Joint); there is residual pain over the 4-5th carpometacarpal joint and thumb basal joint symptoms. Once the wrist arthritis begins, the progression of carpal degeneration will still occur.

In our evaluation, when comparing preoperative strength averages after anesthetic blockade with strength averages 12 weeks after the procedure, there was no statistical difference, showing similarity between the results and a possibility of prediction of the outcome with a simple procedure.

A limitation of the study was that all patients showed improvement in symptoms and strength after the anesthetic blockade, thus avoiding the formation of a group to compare results after arthrodesis. The continuation of the study with a consequent increase in the number of cases may add this variable.

Conclusion

We conclude that our results could propose a new preoperative assessment protocol for patients with TWA indication. Patients who present an excellent response to intra-articular anesthetic infiltration would benefit from the effects of the surgical procedure. The increase in the sample is essential to establish more reliable parameters.

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Conflict of Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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